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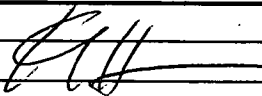
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

Express Mail Label No. **EV335606099US**

INVENTOR(S)				
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)		
Uwe	Limbeck	Kirchheim unter Teck, Germany		
<input type="checkbox"/> Additional inventors are being named on the _____ separately numbered sheets attached hereto				
TITLE OF THE INVENTION (500 characters max)				
METHOD TO COLD-START A FUEL CELL SYSTEM AT SUB-ZERO TEMPERATURES				
CORRESPONDENCE ADDRESS				
Direct all correspondence to:				
<input checked="" type="checkbox"/> Customer Number: 00500				
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ENCLOSED APPLICATION PARTS (check all that apply)				
<input checked="" type="checkbox"/> Specification Number of Pages		12	<input type="checkbox"/> CD(s), Number	
<input checked="" type="checkbox"/> Drawing(s) Number of Sheets		1	<input checked="" type="checkbox"/> Other (specify) Fee Transmittal (+ copy)	
<input checked="" type="checkbox"/> Application Data Sheet. See 37 CFR 1.76				
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT				
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.			Filing Fee Amount	
<input checked="" type="checkbox"/> A check or money order is enclosed to cover the filing fees.			\$160	
<input type="checkbox"/> The Director is hereby authorized to charge filing fees or credit overpayments to Deposit Account Number:			19-1090	
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.				
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.				
<input checked="" type="checkbox"/> No.				
<input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are: _____				
Respectfully submitted,				
SIGNATURE			DATE 5/11/04	May 11, 2004
TYPED or PRINTED NAME	Karl R. Hermanns		REGISTRATION NO. (if appropriate)	33,507
TELEPHONE	(206) 622-4900		DOCKET NUMBER:	130309.498P1

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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16367 U.S. PTO
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60/570052

051104

FEE TRANSMITTAL for FY 2004

Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27.

TOTAL AMOUNT OF PAYMENT (\$) **160**

Complete if Known

Application Number
Filing Date **May 11, 2004**
First Named Inventor **Uwe Limbeck**
Examiner Name
Art Unit
Attorney Docket No. **130309.498P1**

METHOD OF PAYMENT

☒ Payment Enclosed:
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☐ Deposit Account:

Deposit Account Number **19-1090**
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FEE CALCULATION

1. BASIC FILING FEE

Large Entity		Small Entity		Fee Description	Fee Paid
Fee Code	Fee (\$)	Fee Code	Fee (\$)		
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	
SUBTOTAL (1)					160
					(\$ 160)

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

Total Claims	Extra Claims	Fee from below	Fee Paid
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Independent Claims	<input type="text"/>	<input type="text"/>	<input type="text"/>
Multiple Dependent	<input type="text"/>	<input type="text"/>	<input type="text"/>

Large Entity		Small Entity		Fee Description
Fee Code	Fee (\$)	Fee Code	Fee (\$)	
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$)

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity		Small		Fee Description	Fee Paid
Fee Code	Fee (\$)	Fee Code	Fee (\$)		
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
1053	130	1053	130	Non-English specification	
1812	2520	1812	2520	For filing a request for <i>ex parte</i> reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1840*	1805	1840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1480	2254	740	Extension for reply within fourth month	
1255	2010	2255	1005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	
1403	290	2403	145	Request for oral hearing	
1451	1510	1451	1510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1330	2453	665	Petition to revive - unintentional	
1501	1330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)

SUBMITTED BY

Name (Print/Type) **Karl R. Hermanns** Registration No. **33,507**
Signature  Date **May 11, 2004**

Customer Number

00500

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METHOD TO COLD-START A FUEL CELL SYSTEM AT SUB-ZERO TEMPERATURES

The present invention concerns a method to cold-start a fuel cell system at
5 sub-zero temperatures.

One general problem of fuel cell systems is their start-up at low
temperatures, *i.e.*, at temperatures significantly below 0°C. For example, if a fuel cell
system is to be started at a temperature of -15°C, one at first uses a heating device
associated with the fuel cell system to heat the fuel cell system, in particular its stack of
10 membrane-electrode assemblies, to a temperature of for example +5°C, and only then starts
the fuel cell system. This is based on the consideration that the fuel cell system at first has
to be heated to a temperature, above which the water generated by the fuel cell system can
no longer freeze, which would create problems. The heating device may comprise a burner
to generate the required thermal energy, whereby the burner may for example be operated
15 with hydrogen that is also used as fuel for the fuel cell system. The heat generated by the
burner is used to heat a cooling fluid, which circulates in a coolant loop that during the
subsequent operation of the fuel cell stack serves to cool the fuel cell stack. The coolant
heated by the burner of the heating device circulates in the coolant loop and in this manner
transfers the thermal energy to the fuel cell stack to preheat the fuel cell stack.

20 The above-described pre-heating process must be completed in as short a
time period as possible, so that the fuel cell system can be started as quickly as possible,
even at low ambient temperatures. During this, a significant amount of heat has to be
transferred to the coolant in a short time period. This in turn means that a corresponding
air flow has to be supplied to the burner, which can only be accomplished with the help of
25 a powerful fan or a compressor. For this reason, the overall electrical power required prior
to the actual start of the fuel cell system is very high, since it is not only necessary to
operate the above-mentioned fan or compressor, but also the coolant circulating pump and
a control unit that controls the heating process. Since normally the fuel cell stack does not
generate any power during the heating process, the required electrical power is generally

provided by a correspondingly large dimensioned battery. This is undesirable for weight- and space related reasons, in particular for mobile fuel cell applications.

The objective of the invention is to provide an improved method for the cold-starting of a fuel cell system with lower battery energy requirements.

5 Starting with a fuel cell system with a fuel cell stack and a heating device connected upstream of the fuel cell stack to heat a cooling agent to be circulated by a coolant pump, the invention solves this problem by means of the following features: the cold fuel cell stack is operated at a capacity that generates enough power to operate the heating device and the coolant pump; the power generated by the fuel cell is used to
10 operate the heating device for heating the coolant and the coolant pump for circulating the coolant between the fuel cell stack and the heating device; the heating device is switched off as soon as the fuel cell stack has reached a preset temperature that is higher than the original temperature.

The solution according to the invention is based on the capability of a fuel
15 cell system to run at sub-zero temperatures, at least under low load conditions and for a short period of time. It has been known that fuel cell systems can generate power at sub-zero temperatures, see for example U.S. Patent No. 5,798,186, but it is also known that a prolonged operation at sub-zero temperatures can lead to problems, for example due to ice formation in the lines for the reactant streams. For this reason, it was widely assumed that
20 the fuel cell stack is not really suitable as a power source during the cold-start of a fuel cell system. But the invention is based on the finding that even under conditions of this nature the fuel cell stack is able to deliver an amount of power that is at least sufficiently large to operate the heating device, preferably even to operate the coolant pump and an air compressor. The critical factor is the fact that the fuel cell stack can provide this amount of
25 power over a time period that is long enough to heat the fuel cell stack to a temperature above zero before ice formation sets in. Now, a battery or other energy source is only needed for the actual starting of the fuel cell system, but this battery can be much smaller than up to now, since immediately after the below-zero start-up of the fuel cell stack, the latter will provide power.

Preferably, the method according to the invention is implemented in such a way that the fuel cell system will be operated at a capacity that is just barely sufficient to provide the power that is necessary to operate the heating device, the coolant pump, and possibly necessary auxiliaries.

5 A further advantage of the method according to the invention is that the fuel cell stack generates heat immediately after its start-up at sub-zero temperatures, which results in a more rapid heating of the fuel cell stack and thus in a shorter waiting period before the fuel cell system can provide full power.

Even an interruption of the start-up process, which usually takes
10 approximately one minute, is no problem for the invention, since according to the invention the cold fuel cell stack can be operated at low load for a duration of several minutes, which allows three to four successive start-up processes using the method according to the invention.

In one embodiment of the method according to the invention, the preset
15 temperature is +5°C, *i.e.*, the heating device of the fuel cell system is switched off when the fuel cell stack has reached a temperature of +5°C. But it goes without saying that other preset temperatures can be used according to the invention, if these temperatures are sufficiently high to allow the respective fuel cell system to reach its operating temperature without additional external heat input. The present assumption in this regard is that for fuel
20 cell systems with solid polymer electrolytes these preset temperatures have to be above the freezing point, preferably close to or above +5°C.

In preferred embodiments of the method according to the invention, the heating device is a burner. This burner may for example be fuelled with hydrogen, which is of advantage since the fuel cell stack also requires hydrogen for its operation. If the
25 heating device is a burner, then the process of operating the cold fuel cell stack at low load to generate the required power is implemented so that sufficient power is generated to operate the auxiliaries necessary for the operation of the burner (starting device of the burner, fan or compressor for air supply, etc.). Of course, there also has to be sufficient power to operate the coolant pump.

The method according to the invention can realize cost advantages if a burner serves as heating device since neither the burner nor the heat exchanger or heat exchangers have to be rigorously designed for the lowest possible pressure loss, as has been the case traditionally in order to keep the electrical power needed to operate the heating device prior to the actual start-up of the fuel cell system as low as possible. For this reason, according to the invention, both the burner and the heat exchanger or heat exchangers can be designed to be smaller and thus cheaper and more compact.

If a burner serves as the heating device, the method according to the invention can realize further advantages by employing in a preferred embodiment one and the same air compressor to supply both the fuel cell stack and the burner with oxygen. This reduces the power requirements even further.

If in the method according to the invention one employs one and the same air compressor to supply air to both the burner and the fuel cell stack, then the air volume delivered by the air compressor preferably is divided between the burner and the fuel cell in a ratio that favours the burner. In one embodiment, this ratio is 4:1.

Preferably, one uses a high-performance gas burner as burner for the method according to the invention. Such a high-performance gas burner can deliver in a short amount of time the significant amount of heat that has to be transferred to the cooling agent. In preferred embodiment examples, the high-performance gas burner has a power output in a range of approximately 30 kW to 90 kW. Depending on the desired burner output, a burner of this type requires an air mass flow rate of between approximately 50 kg/hr and 300 kg/hr during operation. As mentioned before, one preferably uses hydrogen to operate the burner.

Thus the present invention overall provides a significantly improved method for cold-starting a fuel cell system at sub-zero temperatures, in which the desired short “start-up times” can be achieved despite the lower battery-power requirements and lower space requirements for the smaller components. The term “start-up time” denotes the time period that passes for a cold fuel cell system, before the fuel cell stack is able to deliver its full power.

The enclosed single figure uses the example of a fuel cell stack with a heating device that is connected upstream thereof or integrated therein to illustrate a preferred embodiment example of the method according to the invention.

The single figure shows a diagrammatic representation of a fuel cell stack 10 with one anode 12 and one cathode 14. Hydrogen is supplied to the anode 12 from a source (not shown) via a line 16. Via a line 18, the cathode 14 is supplied with oxygen in the form of air, which has been compressed by a compressor 20. In a manner known in the art, which for this reason will not be explained in more detail, the fuel cell stack 10 during its operation uses the supplied hydrogen and oxygen to produce power and water.

For the purpose of cooling the fuel cell stack 10 during its operation, the fuel cell stack 10 is connected in a heat-exchanging manner to a cooling loop 22, which uses a heat exchanger 23, which is arranged in the cooling loop 22 and is executed as a radiator, to dissipate the excess heat that is produced during the operation of the fuel cell stack 10. The cooling loop 22 also has a heat-exchanging connection to a heating device 24, which during a start-up phase supplies heat to the cooling agent circulating in the cooling loop 22, so that the fuel cell stack 10 can be heated more rapidly to operating temperature from very low ambient temperatures.

In the shown embodiment example, the heating device 24 comprises a high-performance gas burner 26 that is operated with hydrogen and produces hot gas, whereby an additional heat exchanger 28 is used to transfer the thermal energy of the hot gas to the cooling agent circulating in the cooling loop 22. The gas burner 26 is supplied with hydrogen via a line 30, which branches off the line 16. In a mixer 32 upstream of the gas burner 26, hydrogen is mixed with the particular volume of air that is necessary to achieve proper combustion, whereby the compressor 20 delivers this air into the line 18. Control valves 34 and 36 effect the desired distribution of the hydrogen flow and the air flow between the fuel cell stack 10 and the gas burner 26 or mixer 32.

A coolant pump 38 is responsible for circulating the cooling agent through the cooling loop 22. As shown in the figure, the cooling loop 22 typically is a closed loop. In the shown embodiment example, the heat exchanger 23 used to cool the cooling agent

during operation is a different heat exchanger than the heat exchanger 28 that is used to heat the cooling agent during the start-up phase, but it is also possible for the heat exchangers 23 and 28 to employ common components or to be integrated into each other.

The shown arrangement operates as follows: At first the compressor 20 is started with the help of a battery (not shown) and the hydrogen supply via the line 16 is opened, so that air and hydrogen are fed to the fuel cell stack 10. The fuel cell stack 10 commences operation and is set by its control system to operate at low load, *e.g.*, at approximately 10% of its rated power. The power generated by the fuel cell stack 10 is now used to drive the compressor 20, the coolant pump 38, as well as all auxiliaries necessary for the operation of the heating device 24 and the fuel cell stack 10. The heating device 24, in particular its gas burner 26, is started and the hot gas generated by it heats the cooling agent in the cooling loop 22, which is circulated through the cooling loop 22 by the coolant pump 38. In this operating state, the heat exchanger 23 is not operating, *i.e.*, either it is not supplied with cooling agent or the cooling agent circulating in the cooling loop 22 is carried past the heat exchanger 23, for example by means of a bypass line (not shown) that bypasses the heat exchanger 23.

As soon as the fuel cell stack 10 has reached the temperature required for normal operation, for example +5°C, the gas burner 26 is switched off and the fuel cell stack 10 can be operated at a higher load, or at full load, if required. In this operating state the cooling loop 22 serves its actual purpose, namely cooling the fuel cell stack 10 by means of the heat exchanger 23.

In the following, we will use an example to further explain the application of the method of the present invention in a fuel cell system.

For the experiment, we employed a polymer-electrolyte-membrane fuel cell stack with an output power of approximately 85 kW. This fuel cell stack can be operated for approximately 3 to 4 minutes at -15°C and at a load of approximately 5% to 10% of its nominal output power, *i.e.*, with an output power of approximately 4 to 7 kW, before one faces problems due to ice formation or similar factors.

According to the method according to the invention, the fuel cell system only has to be supplied with a quantity of heat that is sufficient to heat the fuel cell stack from -15°C to a temperature from which the fuel cell stack can reach its operating temperature on its own without outside help. In the fuel cell systems under investigation, this temperature was assumed to be $+5^{\circ}\text{C}$. To be able to carry out three to four subsequent start-up processes in rapid succession, each of the start-up processes has to be completed in less than approximately 1 minute.

To heat the fuel cell stack from -15°C to $+5^{\circ}\text{C}$, one has to introduce a computed quantity of heat between 1800 and 2200 kJ into the cooling agent. It is desirably to transfer this amount of heat to the cooling agent within approximately 40 seconds, so that during the remaining 20 seconds the cooling agent can transfer the absorbed heat to the actual fuel cell stack. The listed requirements translate into a power of approximately 45 to 55 kW, which the burner has to be able to generate and the heat exchanger has to be able to transfer. For the burner to generate this quantity of heat, approximately 200 kg/hr of air have to be carried to the burner and subsequently to the heat exchanger. Assuming that an additional 3 to 50 kg/hr of air have to be supplied to the fuel cell stack during the same time period in order for the fuel cell stack to generate the required electrical power, the compressor has to be able to deliver a flow of approximately 230 to 250 kg/hr during the start-up process. In dependence on the pressure gradient that the compressor has to produce, this corresponds to approximately 2 to 5 kW of electrical power that have to be supplied to the compressor. Added to this must be the electrical power of approximately 800 W required by the coolant pump and the approximately 500 W that are needed by additional loads, such as sensors, control systems, etc., so that the fuel cell stack has to generate approximately $3\frac{1}{2}$ to $6\frac{1}{2}$ kW of electrical power during the start-up process.

As explained above, the fuel cell stack is able to generate an output power of this level already during the start-up process, which makes it possible to use a smaller starter battery. A starter battery that only has to be able to start the fuel cell stack only needs an output power of not more than 1.5 kW for less than 5 seconds, whereas a battery that also has to provide power during a cold-start process has to be able to provide a power

output of at least approximately 6 kW for up to 60 seconds. Obviously, a 1.5 kW battery is significantly smaller and cheaper than a 6 kW battery.

The above-mentioned embodiment examples and application examples are only to be considered as examples. It goes without saying that in particular the listed
5 numerical values can differ from one fuel cell system to the next fuel cell system in dependence on the chosen design and the nominal output power.

CLAIMS

1. Method to cold-start a fuel cell system at sub-zero temperatures, whereby the fuel cell system includes a fuel cell stack, upstream of which is connected a heating device to heat a cooling agent to be circulated by a coolant pump, comprising the following steps:

operating the fuel cell stack at an output power in such a way that the generated power is adequate to operate the heating device and the coolant pump,

using the power provided by the fuel cell stack to operate the heating device for the heating of the cooling agent as well as the coolant pump, and circulating the cooling agent between the fuel cell stack and the heating device,

shutting off the heating device when the fuel cell stack has reached a preset temperature that is higher than the original temperature.

2. Method according to claim 1, characterized in that the preset temperature is at least 0 degrees Celsius.

3. Method according to claim 1, characterized in that the preset temperature is at least +5 degrees Celsius.

4. Method according to one of claims 1 to 3, characterized in that the fuel cell stack is operated at a capacity, which does not exceed 10% of the nominal output power of the fuel cell system, until the preset temperature has been reached.

5. Method according to one of claims 1 to 4, characterized in that the heating device is a burner.

6. Method according to claim 5, characterized in that to operate the burner, power is provided from the fuel cell stack to the auxiliaries necessary for the operation of the burner.

7. Method according to claim 5 or 6, characterized in that the burner is operated with hydrogen.

8. Method according to one of claims 5 to 7, characterized in that one and the same air compressor is used to supply oxygen to the fuel cell stack and to the burner.

9. Method according to one of claims 5 to 8, characterized in that the burner is a high-performance gas burner.

10. Method according to claim 8 or 9, characterized in that the air volume provided by the air compressor is divided between the burner and the fuel cell stack with a ratio that favours the burner.

11. Method according to claim 10, characterized in that the air volume provided by the air compressor is divided between the burner and the fuel cell stack with a 4:1 ratio.

12. Method according to one of claims 1 to 11, characterized in that the fuel cell stack is a solid-polymer-electrolyte fuel cell stack.

13. Method according to one of claims 1 to 12, characterized in that the fuel cell system is equipped with a starter battery.

14. Method according to claim 13, characterized in that the starter battery is dimensioned to supply electrical power to the auxiliaries necessary for the supply of reactants to the fuel cell stack until the fuel cell stack itself generates electrical power.

15. Method according to claim 13 or 14, characterized in that in a first stage the starter battery supplies power to the auxiliaries necessary for the supply of reactants to the fuel cell stack, and that this power feed is interrupted when the fuel cell stack generates electrical power.

ABSTRACT

The invention concerns a method to cold-start a fuel cell system at sub-zero temperatures, whereby the fuel cell system comprises a fuel cells stack, upstream of which is connected a heating device to heat a cooling agent to be circulated by a coolant pump. To reduce the demand for stored electrical energy, the method stipulates the following: the cold fuel cell stack is operated at such a capacity that it generates sufficient power to operate the heating device and the coolant pump; the power generated by the fuel cell stack is used to operate the heating device for heating the cooling agent as well as the coolant pump, whereby the coolant pump circulates the cooling agent between the fuel cell stack and the heating device; the heating device is switched off as soon as the fuel cell stack reaches a preset temperature that is higher than the original temperature.

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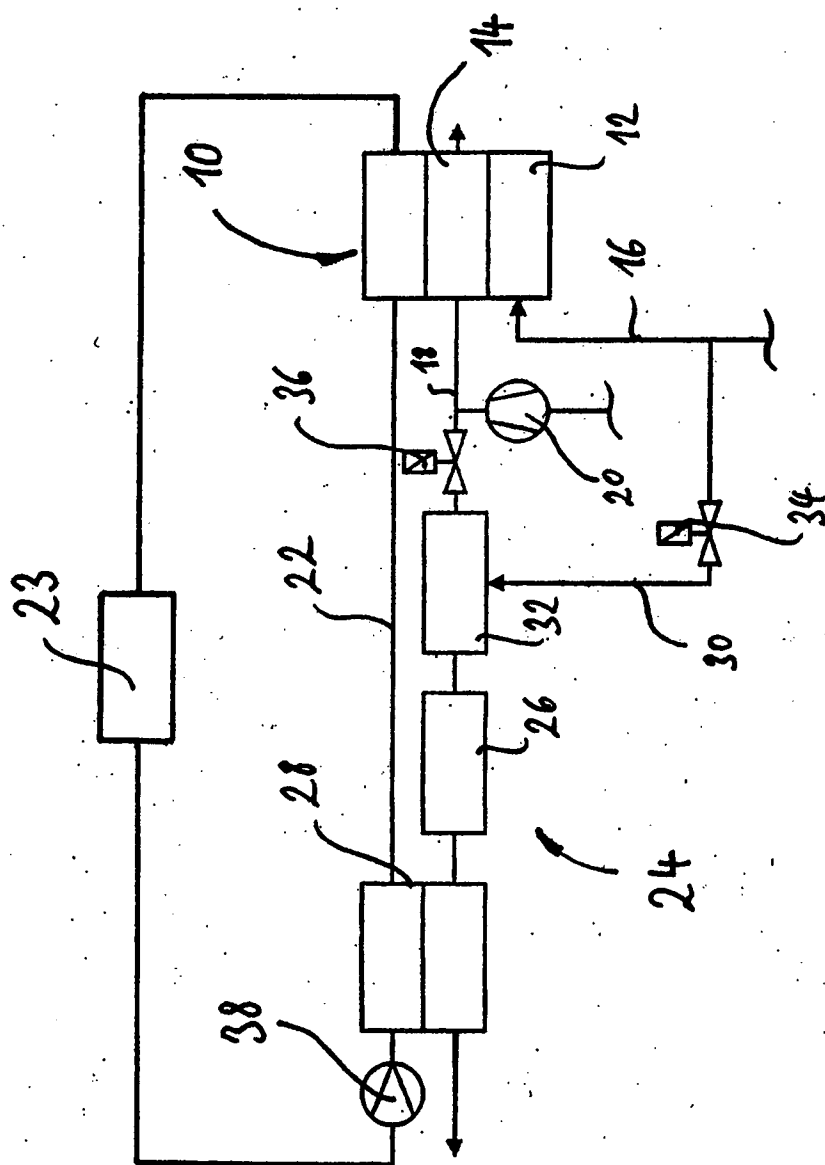


Fig.

APPLICATION DATA SHEET**Application Information**

Application number::

Filing Date::

Application Type::

Provisional

Subject Matter::

Utility

Suggested classification::

Suggested Group Art Unit::

CD-ROM or CD-R?::

None

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Number of copies of CDs::

Sequence submission?::

Computer Readable Form (CRF)?::

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Number of copies of CRF::

Title ::

METHOD TO COLD-START A FUEL CELL
SYSTEM AT SUB-ZERO TEMPERATURES

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130309.498P1

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No

Request for Non-Publication?::

No

Suggested Drawing Figure::

Total Drawing Sheets::

1

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No

Petition included?::

No

Petition Type::

Licensed U.S. Gov't Agency::

Contract or Grant No::

Secrecy Order in Parent Appl.?::

No

First Applicant Information

Applicant Authority Type:: Inventor
Primary Citizenship Country:: Germany
Status:: Full Capacity
Given Name:: Uwe
Middle Name::
Family Name:: Limbeck
Name Suffix::
City of Residence:: Kirchheim unter Teck
State or Province of Residence::
Country of Residence:: Germany
Street of mailing address:: Milcherberg 9
City of mailing address:: Kirchheim unter Teck
State or Province of mailing address::
Country of mailing address:: Germany
Postal or Zip Code of mailing address:: 73230

Correspondence Information

Correspondence Customer Number :: **00500**

Representative Information

Representative Customer Number::		00500
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Domestic Priority Information

Application ::	Continuity Type::	Parent Application::	Parent Filing Date::

Foreign Priority Information

Country::	Application number::	Filing Date::	Priority Claimed::

Assignee Information

Assignee name::	
Street of mailing address::	
City of mailing address::	
State or Province of mailing address::	
Country of mailing address::	
Postal or Zip Code of mailing address::	